Amendments to the Drawings:

Applicants' are providing five replacement sheets that provide better reproducibility of Figs. 1, 2, 3, 4, 6, 7 and 9. Additionally, in Fig. 4, the word "TRESHOLD" was changed to "THRESHOLD" and the phrase "GLOBAL TRESH" was changed to "GLOBAL THRESH". In Fig. 8A, "V_{THRES}" was changed to "V_{THRESH}".

Attachment: Five (5) Replacement Sheets

Two (2) Annotated Sheets Showing Changes Made

Remarks:

Applicants appreciatively acknowledge the Examiner's confirmation of receipt of Applicants' claim for priority and certified priority document under 35 U.S.C. § 119(a)-(d).

Reconsideration of the application, as amended herein, is respectfully requested.

Claims 26 - 51 are presently pending in the application. Original claims 1 - 25 have been canceled. New claims 26 - 51 have been added.

Applicants gratefully acknowledge that item 12 of the above-identified Office Action indicated that former claims 8, 9. 21 and 22 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

In item 1 of the Office Action, the drawings were objected to because Figs. 1 - 4, 6 and 9 contained text and shaded areas that allegedly became illegible when reproduced electronically. Applicants' are providing five replacement sheets that provide better reproducibility of Figs. 1, 2, 3, 4, 6, 7 and 9. Additionally, in Fig. 4, the word "TRESHOLD" was changed to "THRESHOLD" and the phrase "GLOBAL TRESH" was

changed to "GLOBAL THRESH". In Fig. 8A, "V_{THRES}" was changed to "V_{THRESH}".

In item 2 of the Office Action, the drawings were objected to as allegedly not showing the claimed "layer of photosensitive material". Applicants respectfully disagree. More particularly, the claimed "layer of photosensitive material" is shown in Figs. 1, 2 and 7 of the instant application as the doped semiconductor p^+, n^+, n^{++} trespassing section 4. Applicants' new claims 26, 36 and 44 recite, among other limitations: a layer of photosensitive material; and an NxM array of photodetector diodes **formed using the layer of photosensitive material**. This is shown, for example, in Fig. 2 of the instant application, and described in paragraphs [0084] and [0086] of the published version of the instant application, which state, respectively:

> [0084] FIG. 1 illustrates schematically the architecture of a photodetector diode 2 having a doped semiconductor p^+, n^+, n^{++} trespassing section 4. The material choosen for the photodetector diode 2 depends on the desired bandgap energy required to generate an electron hole pair by the photo-effect. Suitable materials are undoped amorphous silicon having band gap of 1.12 eV and a bundle of IV-IV compounds and III-V compounds (indium and gallium salts, like gallium arsenide or indium antimonide). [emphasis added by Applicants]
>
> . . .
>
> [0086] FIG. 2 shows a schematical view of a two-dimensional pixel detector 14 having a number of

> photodetector diodes 2 arranged in an array of 22 rows and 32 columns (compare FIG. 6). The photodetector diodes 2 have a length l and a width w of about 200 µm and a height of about 300 µm. Below the plane of these photodetector diodes 2 a readout chip 16 having a corresponding number of readout unit cells 18 is arranged for collecting the charge from the electron hole pairs 10 generated in the respective photodetector diodes 2. The electrical conjunction between a diode output interface 20 of the photodetector diodes 2 and an input interface 22 of the readout unit cells 18 is achieved by bump bonding using indium bumps 24.

As such, as can be seen from Fig. 2 of the instant application, the two-dimensional pixel detector 14 of Applicants' Fig. 2 includes a layer of photosensitive material 4 of Fig. 2, which is used to form a plurality of photodetector diodes 2 of Fig. 2 arranged in an array, each of which is formed with a portion of the layer of photosensitive material 4. As such, it is believed that Applicants' particularly claimed layer of photosensitive material, from which the plurality of diodes are formed, is shown in the drawings, and supported by the specification.

In item 3 of the Office Action, claims 6, 7, 10,14 - 18 and 23 - 25 were objected to as being improperly dependent from other claims, or in the case of claim 10, itself. It is believed that the above-rejections are moot in view of the amendments to the claims made herein.

In item 4 of the Office Action, claims 1 and 13 were objected to as containing typographical and/or grammatical errors. It is believed that the above-rejections are moot in view of the amendments to the claims made herein.

In item 5 of the Office Action, claims 5, 9, 11, 13 and 24 were rejected as allegedly being indefinite under 35 U.S.C. § 112, second paragraph. It is believed that the above-rejections are moot in view of the amendments to the claims made herein.

In item 6 of the Office Action, claims 1 - 25 were rejected as allegedly being indefinite under 35 U.S.C. § 112, second paragraph for reciting a layer of photosensitive material layer containing the photodetector diodes. It is believed that the above-rejections are moot in view of the amendments to the claims made herein. As stated above, it is believed that Applicants' particularly claimed layer of photosensitive material, from which the plurality of diodes are formed, is shown in the drawings, and supported by the specification.

It is accordingly believed that the claims meet the requirements of 35 U.S.C. § 112, second paragraph.

In item 7 of the Office Action, claims 1, 2, 4 and 5 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over U. S. Patent No. 5,665,959 to Fossum et al ("**FOSSUM1**") in view of U. S. Patent No. 5,856,666 to Moulsley ("**MOULSLEY**"). In item 8 of the Office Action, claim 3 was rejected under 35 U.S.C. § 103(a) as allegedly being obvious over **FOSSUM1**, in view of **MOULSLEY**, and further in view of U. S. Patent No. 5,236,871 to Fossum et al ("**FOSSUM2**"). In item 9 of the Office Action, claims 11 - 13 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over **FOSSUM1**, in view of **MOULSLEY**, and further in view of United Kingdom Patent No. GB 2,294,540 to Matcher ("**MATCHER**"). In item 10 of the Office Action, claim 19 was rejected under 35 U.S.C. § 103(a) as allegedly being obvious over **FOSSUM1**, in view of **MOULSLEY**, and further in view of U. S. Patent No. 5,107,103 to Gruss et al ("**GRUSS**"). In item 11 of the Office Action, claim 20 was rejected under 35 U.S.C. § 103(a) as allegedly being obvious over **FOSSUM1**, in view of **MOULSLEY** and **GRUSS**, and further in view of U. S. Patent No. 5,970,115 to Colbeth et al ("**COLBETH**").

Applicants respectfully traverse the above rejections, as applied to the newly presented claims.

More particularly, claim 26 recites, among other limitations:

f) each readout unit cell including:

. . .

a digital counter unit including a digital counter and a digital counter output interface connected in series, **each digital counter unit counting an output signal of the comparator unit, said output signal being proportional to a number of electron/hole pairs generated by a photon in the respective photodetector diode**;

g) a multiplexing unit including a row select and a column select circuit allowing to access each readout cell unit, **to read out the digital data as actually stored in the digital counter** to the digital counter output interface; [emphasis added by Applicants]

As such, Applicants' claim 26 requires the multiplexing unit to **access each readout cell unit to read out the digital data, as actually stored in the digital counter (i.e., which is an output signal proportional to a number of electron/hole pairs generated by a photon in the respective photodetector diode)**. This can be seen, for example, from Fig. 4 of the instant application, wherein the **actual digital data is stored in a 15 bit SR counter SRC, which is output to a bus RB.** See also, for example, paragraph [0092] of the published copy of the instant application, which states:

Downstream to the analog block 46 is **the digital block 48 having generally the task to convert the digital output voltage signal into a digital counter signal that can be evaluated by multiplexing means MM** provided with the data processing means DPM. Together with a enable/disenable switch E/D different clock means, i.e. an external clock RCLK from the data

> processing means DPM control a clock generator CG for a digital counter unit SRC which itself is connected to a readout bus output RBO. **The digital data stored in the digital block 48 of a distinct readout unit cell can then be readout if a row select RS and column select CS are set high to set high an AND-gate &.** [emphasis added by Applicants]

In contrast to Applicants' claimed invention, the **FOSSUM1** reference does **not** teach or suggest, among other limitations of Applicants' claims, **a multiplexer accessing each readout cell unit, to read out the digital data as actually stored in the digital counter,** as required by Applicants' claim 26. Rather, as disclosed in paragraph [0003] of the published copy of the instant application, **FOSSSUM1** discloses a counter wherein any incident photon occurring during the sampling period generates a photoelectron at the output of the detector diode connected to the input of the amplifier. In **FOSSUM 1,** that photoelectron changes the potential of the buffer amplifier's **input capacitance**, which causes the high-gain buffer amplifier to present a sufficiently large voltage change at the output of the amplifier to be above the system noise level. This can be seen, for example, from col. 7 of **FOSSUM1**, lines 10 - 34, which state:

> The unit-cell amplifiers are of high enough gain and low enough noise that the voltage change at the column bus (ΔV_{out}) is sufficient to allow discrimination between presence or absence of photoelectrons in the capacitor C_{in}. Since the gain amplifiers A1 and A2 are required for boosting the ΔV_{out} signal enough to allow proper thresholding, gain uniformity in the amplifiers is not a concern. The high step voltage ΔV_{out} placed on

> the column bus by closing switch SW2 is differentiated at the counter selected from a column of counters by a multiplexer (not shown) that selects only the one counter associated with the one unit cell in the case of one counter for each cell or the only counter associated with a column of unit cells in the case of time sharing a row of counters with all rows of unit cells in the array. **In either case, the counter differentiates the step voltage so that a trigger pulse if produced by the step in the voltage when the switch SW2 is closed. Thus, the pixel readout circuit permits counting of individual photoelectrons over a number of sampling periods between Q_{sel} clock pulse cycles set by the multiplexer to produce a bit 1 output of amplifier A2 if at least one photon has been converted by the photodetector diode into one photoelectron which adds a potential 1 mV/e^- to the potential stored in the capacitor C_{in}.** [emphasis added by Applicants]

Thus, **FOSSUM1** discloses a **pixel readout circuit that permits counting of individual photoelectrons over a number of sampling periods between Q_{sel} clock pulse cycles set by the multiplexer to produce a bit 1 output of amplifier A2 if at least one photon has been converted by the photodetector diode into one photoelectron which adds a potential 1 mV/e^- to the potential stored in the capacitor C_{in}.** In other words, in **FOSSUM1** the multiplexer produces a bit 1 output if the **capacitor** (i.e., an analog storage) indicates that a photon has been detected. Neither the **analog** value of the capacitor of **FOSSUM1**, nor the bit 1 output **generated** by the multiplexer of **FOSSUM1** teaches or suggests, among other limitations of Applicants' claims, **a multiplexer accessing each readout cell unit, to read out the digital data as actually stored in the digital counter**, as required by Applicants' claim 26. The

MOULSLEY reference, cited in the Office Action in combination with **FOSSUM1** against Applicants' former claim 1 (corresponding to current claim 26), does not cure the above-discussed deficiencies of the **FOSSUM1** reference. As such, Applicants' claim 26 is believed to be patentable over **FOSSUM1** and **MOULSLEY**, whether taken alone, or in combination.

Similarly, Applicants' new claim 36 recites, among other limitations:

> f) each readout unit cell including:
>
> . . .
>
> a digital counter unit including a digital counter and a digital counter output interface connected in series, **each digital counter unit counting an output signal of the comparator unit, <u>said output signal being proportional to a number of electron/hole pairs generated by a photon in the respective photodetector diode</u>;** [emphasis added by Applicants]

As such, Applicants' claim 36 requires, among other limitations, **an array of readout unit cells, each of which includes a digital counter unit for counting an output signal of the comparator unit <u>that is proportional to a number of a number of electron/hole pairs generated by a photon in the respective photodetector diode</u>**. However, as discussed above in connection with claim 26, the **FOSSUM1** reference does <u>not</u> disclose **a comparator that outputs a signal that is proportional to a number of electron/hole pairs generated by a**

photon in the respective photodetector diode, which output signal is stored (i.e., "counted") by the digital counter. Rather, as pointed out on page 7 of the Office Action, the alleged "comparator" of FOSSUM1 merely discriminates "between presence or absence of photoelectrons". This can be seen from col. 7 of FOSSUM1, lines 11 - 15 (cited on page 7 of the Office Action), which state:

> The unit-cell amplifiers are of high enough gain and low enough noise that the voltage change at the column bus (ΔV_{out}) **is sufficient to allow discrimination between presence or absence** of photoelectrons in the capacitor C_{in}. [emphasis added by Applicants]

The mere discrimination between the presence or absence of photoelectrons, as disclosed in FOSSUM1, does not teach, suggest or motivate to a person of skill in this art, a digital counter that counts an output signal from a comparator, which output signal is proportional to a number of electron/hole pairs generated by a photon in the respective photodetector diode, as required by Applicants' claim 36 (as well as, claim 26). The MOULSLEY and MATCHER references, cited in the Office Action in combination with FOSSUM1 against Applicants' former claim 12 (corresponding to current claim 36), do not cure the above discussed deficiencies of the FOSSUM1 reference. For the foregoing reasons, among others, Applicants' claim 36 is believed to be patentable over the

combination of the **FOSSUM1**, **MOULSLEY** and **MATCHER** references, whether taken alone, or in combination.

Additionally, Applicants' claim 44 (corresponding to Applicants' former claim 19) recites, among other limitations:

> d) **each readout unit cell including** **an internal data processing unit** allowing to assign each output signal representing an incident photon or a predetermined number of incident photons in the corresponding photodetector diode to a preselectable region of interest; [emphasis added by Applicants]

This processing unit, **internal** to **each** readout cell, is described in the specification of the instant application, for example, in paragraph [0109] of the published copy of the instant application, which states, in part:

> Within the normal counting operation, the output signal OS is processed with the pulse generator and the counter SRC. **With respect to the selection of a specific region of interest ROI as shown in FIG. 6, the signal after the pulse generator PG is processed to a region of interest unit ROI SEL that can be programmed by a port PRG_ROI. The region of interest unit ROI SEL so far administrates the incoming signal from the pulse generator PG and assigns these signals to the predefined region of interest ROI.** By the way, it should be mentioned that a number of different regions of interests ROI(0, . . . , K) can be predetermined although only one region of interest is shown in FIG. 6. The assignment is made by setting an output signal to the respective region of interest output interface $ROI(0, \ldots, K)_{out}$ which is connected to the data processing means DPM. The occurrence of this output signal is accompanied by a time stamp which is stored to the data processing means DPM with reference to the respective region of interest ROI. [emphasis added by Applicants]

As such, in the invention of Applicants' claim 44, **each readout unit cell includes an internal data processing unit** (i.e,. ROI SEL of Fig. 9 of the instant application) for performing a particularly claimed function. However, such an internal processing unit is not taught or suggested in the cited prior art.

More particularly, Applicants' former claim 19 (i.e., current claim 44) was rejected in item 10 of page 9 of the Office Action, which stated:

> Claim 19 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Fossum et al. and Moulsley, in further view of Gruss et al. (5,107,103).
>
> With respect to claim 19, the combination as applied to claim 1 above, does not specifically show assigning an output signal with a time stamp. However, the practice of assigning a time stamp to a detected signal from a photodiode array is commonly known in the art and would have been obvious to one having ordinary skill in the art at the time the invention was made. Gruss is cited as an example of such practice (column 3, lines 40 - 65).

As can be seen, the Office Action did not, separately, point out where in the references Applicants' particularly claimed **data processing unit, internal to each readout cell**, could be found. Rather, item 10 of the Office Action referred back to the rejection of Applicants' former claim 1. Page 7 of the Office Action points to the "control unit" of Fig. 7 of **FOSSUM1**, as allegedly showing the claimed "data processing

means" of Applicants' former claim 1. However, as can be seen, more particularly, from Fig. 7 of **FOSSUM1**, the control unit (26 of Fig. 7 of **FOSSUM1**) **is not internal to each readout unit cell, but instead, is external to the entire buffer memory.** Fig. 7 of **FOSSUM1**, illustrating the control unit 26 being **external** to **all** of the readout cells, is reproduced herebelow, for convenience.

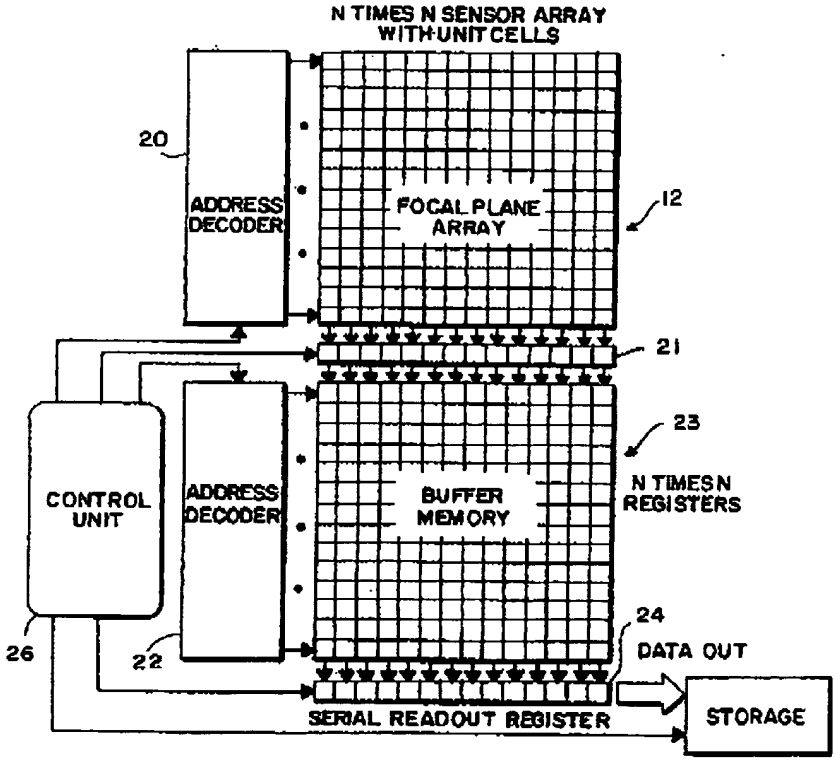


FIG. 7

Fig. 3 of **FOSSUM1** shows a basic schematic diagram of a "unit cell" for one photodetector diode of the solid state array which is connected between a photovoltaic type of

photodetector diode and a column bus for readout. As can be seen from **FIG. 3 of FOSSUM1, the "unit cell" 15 of Fig. 3 of FOSSUM1 does not include an internal data processing unit.** Fig. 3 of **FOSSUM1** is additionally being reproduced herebelow, for convenience.

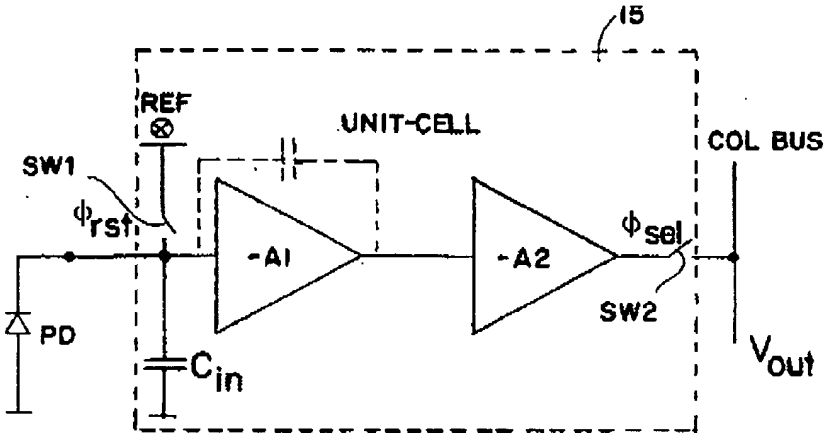


FIG.3

See also, for example, col. 6 of **FOSSUM1**, line 50 - col. 7, line 62, describing the unit cell of Fig. 3 of **FOSSUM1**. Thus, among other limitations of Applicants' claims, the **FOSSUM1** reference fails to teach or suggest **each readout cell including an internal data processing unit**, as required by Applicants' claim 44. The **MOULSLEY** and **GRUSS** references, cited in item 10 of the Office Action in combination with **FOSSUM1** against Applicants' former claim 19 (current claim 44), do not cure the above discussed deficiencies of the **FOSSUM1** reference.

For the foregoing reasons, among others, Applicants' claims are believed to be patentable over **FOSSUM1**, **MOULSLEY**, **FOSSUM2**, **MATCHER**, **COLBETH** and **GRUSS**, whether taken alone, or in combination.

It is accordingly believed that none of the references, whether taken alone or in any combination, teach or suggest the features of claims 26, 36 and 44. Claims 26, 36 and 44 are, therefore, believed to be patentable over the art. The dependent claims are believed to be patentable as well because they all are ultimately dependent on claims 26, 36 or 44.

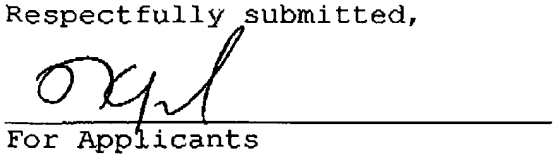
In view of the foregoing, reconsideration and allowance of claims 26 - 51 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate receiving a telephone call so that, if possible, patentable language can be worked out.

If an extension of time for this paper is required, petition for extension is herewith made.

Please charge any fees that might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner Greenberg Stemer LLP, No. 12-1099.

Respectfully submitted,



For Applicants

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Applic. No. 10/539,837
Reply to Office Action dated 04/29/2008
Amendment dated 07/29/2008
Annotated Sheet

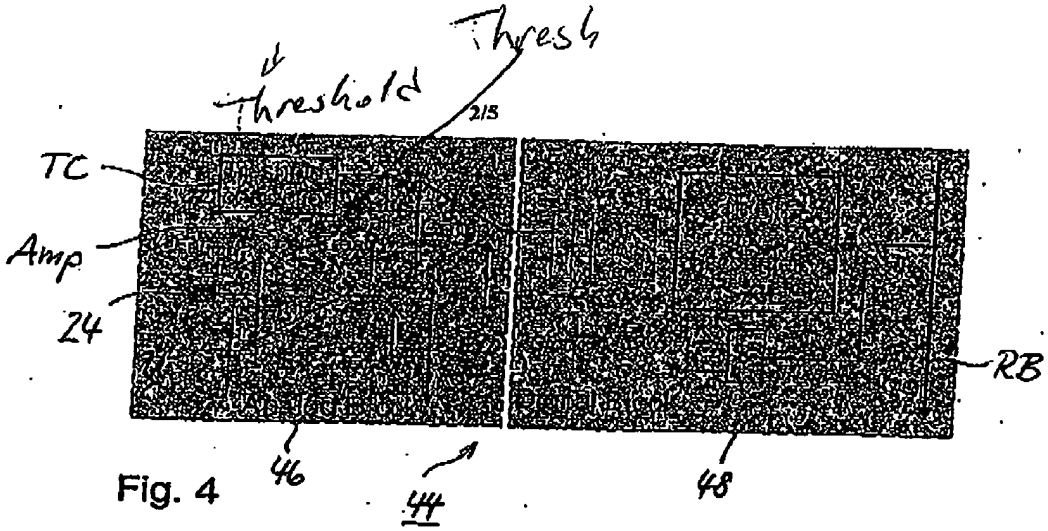

Fig. 4

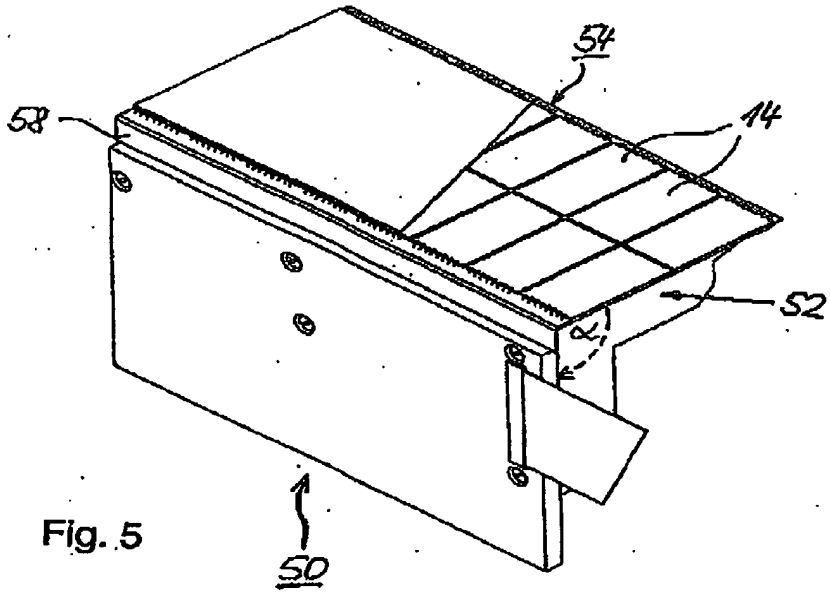

Fig. 5

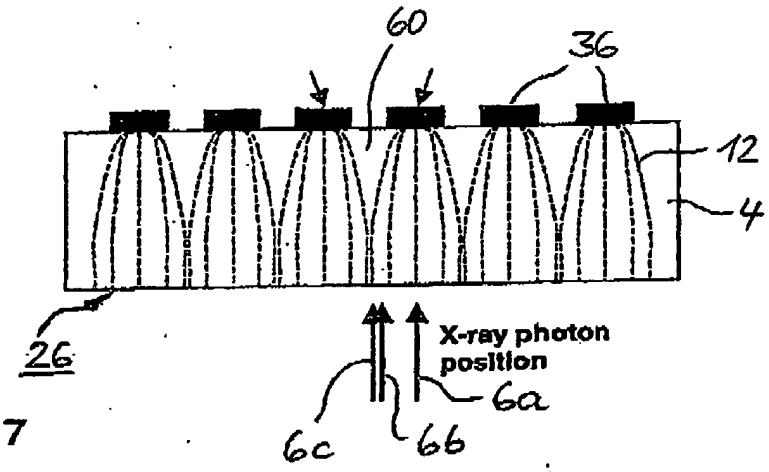
60
36
12
4
26
X-ray photon position
6a
6c
6b

Fig. 7

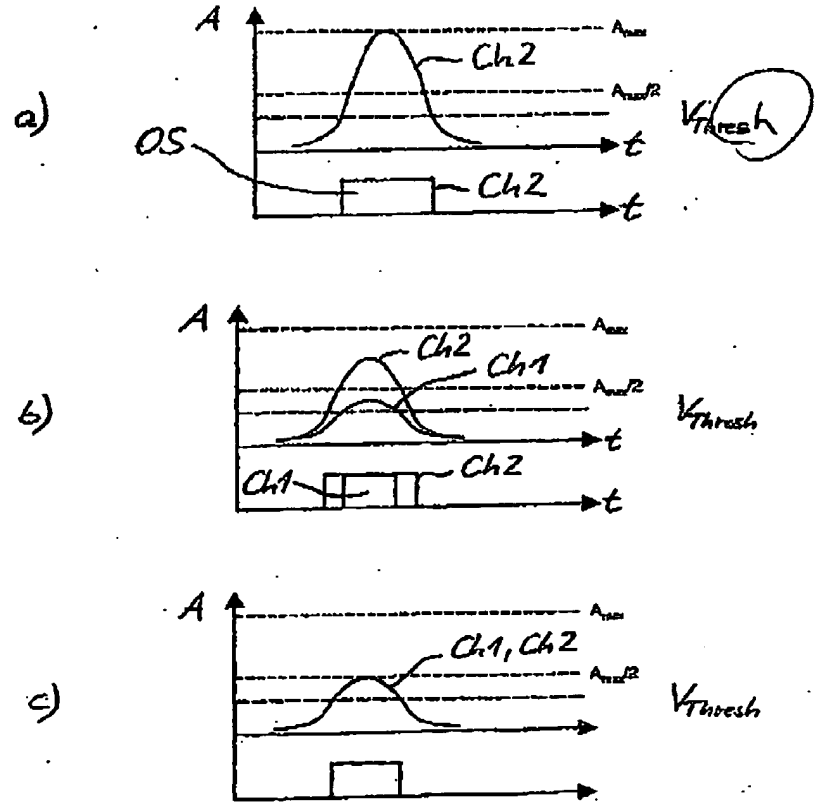
a)
A
Ch2
t
OS
Ch2
t
b)
A
Ch2
Ch1
t
Ch1
Ch2
t
c)
A
Ch1, Ch2

Fig. 8